United States Patent

Schleich

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[54] APPARATUS FOR TREATING A CONTINUOUS BODY UNDER PRESSURE

[72] Inventor: **Nicholas P. Schleich**, Golf, Ill.

[73] Assignee: **The Matix Corporation**

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[52] **U.S. Cl.** .....**95/89 G**, 34/218, 95/94, 355/27

[51] **Int. Cl.** **G03d 3/00**, G01c 9/12, G03b 27/32

[58] **Field of Search** 95/89, 94; 34/218; 355/27

[56] **References Cited**

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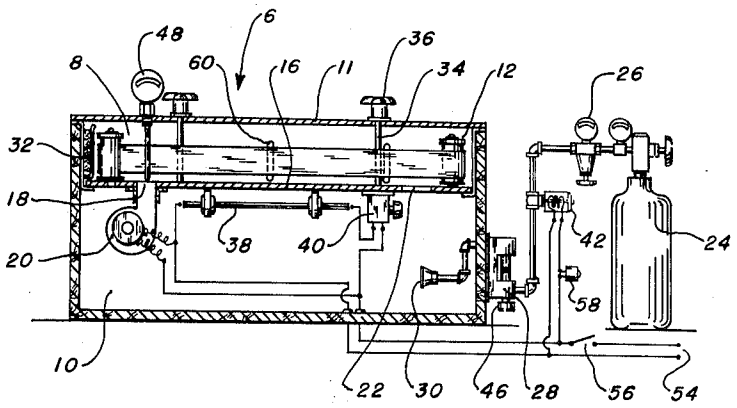
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Primary Examiner—Samuel S. Matthews
Assistant Examiner—Richard A. Wintercorn
Attorney—Harry P. Eichin

[57] **ABSTRACT**

A method and apparatus for developing the latent image on a continuous flexible diazo web by subjecting the web to a heated pressurized atmosphere of ammonia in a sealed chamber.

5 Claims, 8 Drawing Figures



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SHEET 1 OF 2

Fig. 1

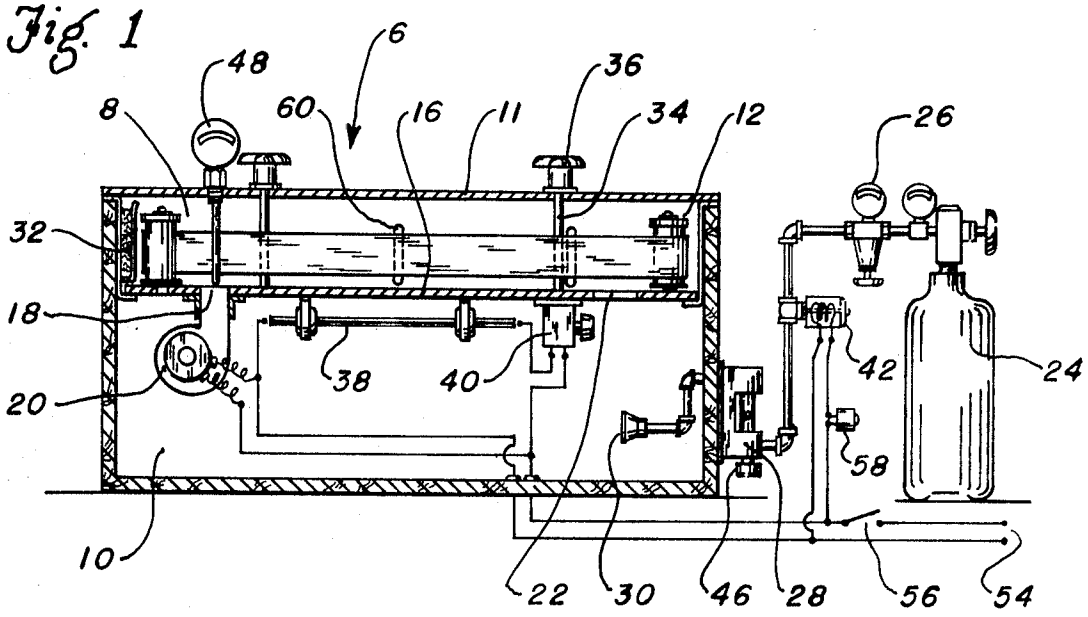
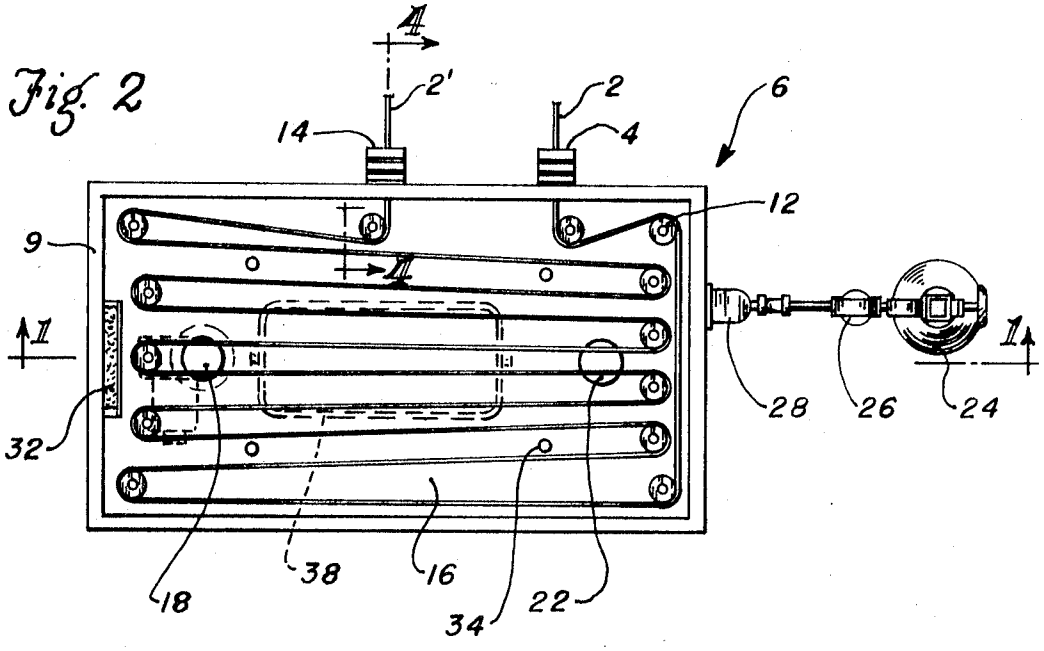


Fig. 2



Inventor

Nicholas P. Schleich

Fig. 3

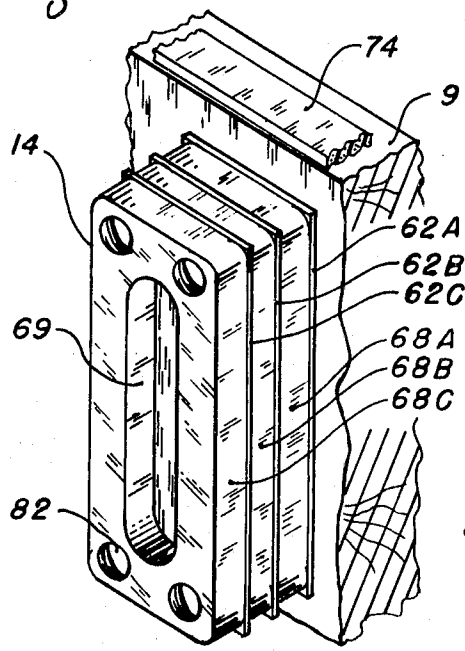
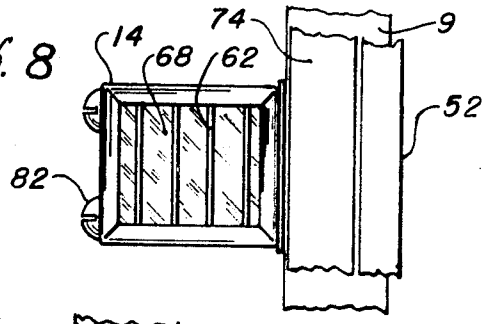


Fig. 8



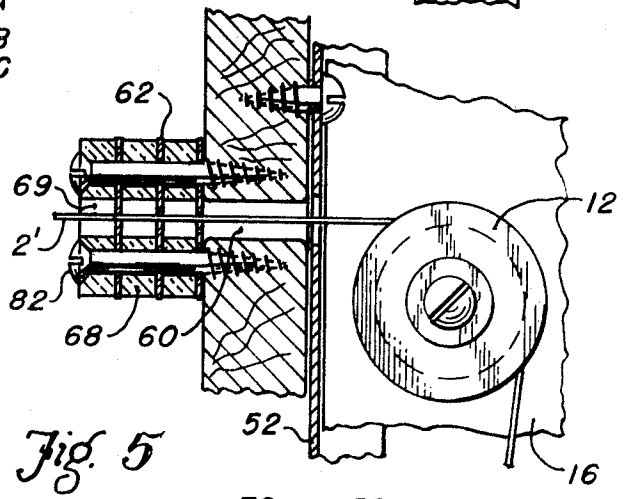


Fig. 5

Fig. 6

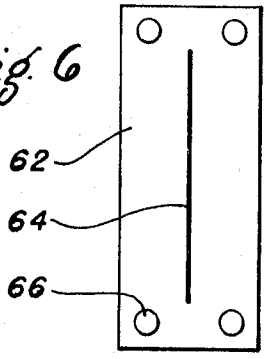
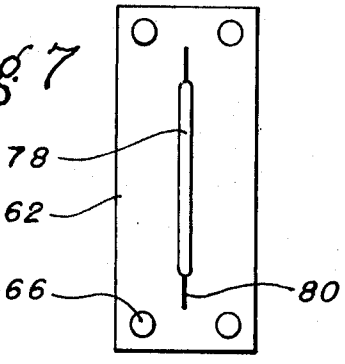


Fig. 7



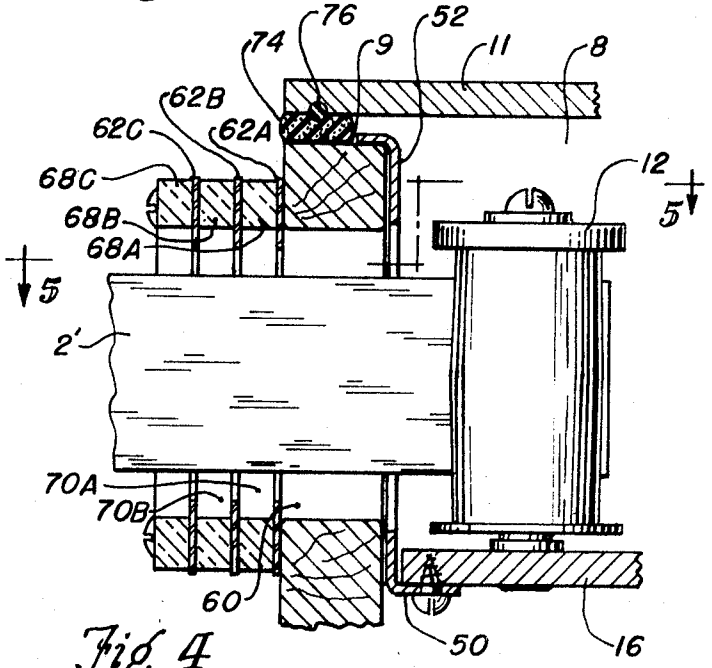


Fig. 4

Inventor
Nicholas P. Schleich

APPARATUS FOR TREATING A CONTINUOUS BODY UNDER PRESSURE

This invention relates to a method and apparatus for treating uniformly shaped bodies or structures at pressures different from that of the ambient atmospheric pressure. More particularly, the invention relates to a method and apparatus for developing the latent image on an exposed continuous web, film, or foil.

It is known that a diazo type film, in contact with an original print, when exposed to high intensity light, forms a latent image on the film. The diazo film, having the latent image, is then separated from the original print and conveyed to a developer, while the original is delivered to a predetermined location or windup. In general, the film, having the latent image, is passed into a developer where the exposed sensitized material is subjected to the vapors of a volatile developing agent such as heated vaporized aqueous ammonia. In other developers the web with the latent image is passed through an aqueous ammonia solution as the developing agent.

It is essential that s sufficient quantity of ammonia and moisture be present at the proper temperature for satisfactory reaction. When gaseous ammonia is used for developing the latent image, generally aqueous ammonia vaporized in a confined enclosure is utilized for this purpose, and the sensitized material is subjected to the vapors. One method for vaporization has been effected by allowing small quantities of the aqueous ammonia to drop onto an electrical heating unit. There is some cooling on vaporization, and uniform distribution of the reactive gas is a problem. In other systems the reactive gas is evaporated from a heater element located inside a liquid storage tank. Other forms of ammonia generation have been used, such as heat decomposition of ammonium carbonate, feeding of anhydrous ammonia and the like, but, again, there were problems of moisture addition and provision for an adequate, uniform supply of ammonia.

In the prior art systems of development, problems were encountered in attempting to seal the web with the latent image against a perforated wall of a gas-filled chamber. This system used a moveable sealing sleeve to convey and press the web against the surface of the perforated wall. The sensitized surface of the web often became scratched. Also, temperature control was difficult, and a cooled portion would result in condensation and fogging.

In most all the systems no satisfactory means were provided to maintain the ammonia gas within the confines of the developing chamber, while continuously advancing the web therethrough, and the permeation of the gas from the chamber into the surrounding atmosphere necessitated thorough venting of the work area.

In a particular embodiment, the invention relates to a method and apparatus for developing a continuous web of exposed diazo sensitized material having a latent image thereon, by subjecting the material to a heated moisturized ammonia gas environment in a sealed chamber, allowing the web to enter and exit from the sealed chamber through a pressure limiting capsule with negligible permeation or migration of the ammonia gas into the surrounding atmosphere.

It is an object of this invention to provide a method and apparatus for sealing the entry or inlet port and exit or outlet port of a chamber to minimize permeation of gas into or from the chamber.

It is another object of this invention to provide sealing means for the ingress and egress of a continuous web from the ports of a developing or treating chamber to substantially prevent the migration or permeation of gas from the chamber or leakage into the chamber while a body, web, film, or foil is being fed into and removed from the developing chamber.

It is another particular object to provide a method and apparatus for developing a latent image on diazo film.

Other objects and advantages will become apparent from the following description of the invention, when taken with reference to the accompanying Figures of the drawing in which

FIG. 1 is a schematic side sectional view of one embodiment of the apparatus taken along line 1—1 of FIG. 2.

FIG. 2 is a top view of the apparatus of FIG. 1 - showing the developing chamber with the cover removed.

FIG. 3 is an enlarged perspective view of a pressure limiting capsule.

FIG. 4 is an enlarged side section view taken along line 4—4 of FIG. 2 showing the film web passing through a pressure limiting capsule.

FIG. 5 is a top sectional view taken along line 5—5 of FIG. 4 showing the film web passing from the developing chamber through the outlet pressure limiting capsule.

FIG. 6 is a plan view of a diaphram having a slit.

FIG. 7 is a plan view of a diaphram of an alternate embodiment.

FIG. 8 is a top view of a preassembled pressure limiting capsule affixed to an entry port of the developer with the cover removed.

The invention will be described with reference to one particular embodiment for developing a latent image on diazo microfilm having a light sensitive coating.

Referring now to FIG. 2 which is a top view of the developing compartment of treating chamber with the cover removed, there is shown the exposed but undeveloped film 2 being fed from a source not shown, such as an unwind reel, through a pressure limiting capsule 4 hereinafter described, into treating apparatus generally designated as 6, which is comprised of an upper developing chamber 8 and a lower supply chamber 10 as shown in FIG. 1. The exposed but undeveloped film 2, after entering the development chamber 8 through the pressure limiting capsule 4 sealing the inlet port, is passed around idler transport and guide rollers all designated 12. The developed film 2', after proper residence time in the developing chamber 8, then passes through the pressure limiting capsule 14 sealing the outlet or exit port of the developing chamber to a collecting station or driven windup, not shown. The transport rollers 12 are positioned vertically and secured to a heat radiating panel 16 positioned parallel to the travel of the film. The heat radiating panel 16 is positioned below the film, and is preferably conterminous with said treating apparatus to sectionalize and separate the apparatus into an upper developing chamber 8 and a lower supply chamber 10 as shown in FIG. 1.

Ammonia gas is circulated in the developing chamber 8 under a moderate pressure, and is blown into the developing chamber from the supply chamber 10 through the gas supply port 18 in one end of heat radiating panel 16, by means of a centrifugal blower 20 shown in FIG. 1 positioned to have its intake in the supply chamber 10. A gas return port 22 in the heat radiating panel 16 is spaced from the gas supply port 18, and is preferably on the opposite end of the panel. The reactive ammonia gas is continuously supplied to the supply chamber 10 from a standard anhydrous ammonia tank 24 externally connected to the apparatus through pressure regulating valves 26 to control the output pressure of the supply tank 24, reducing the pressure to low levels of about 0.1 to 3 p.s.i.g. The anhydrous ammonia gas is fed from the regulating valves to an adjustable ball suspension flow meter 28 through a conduit sealed into one of the walls 9 of the supply chamber and then to a dispensing nozzle 30 positioned in the supply chamber 10.

A moisture reservoir 32, which in its simplest embodiment comprises a sponge to imbibe water, is affixed to a wall by a U shaped clip at one end of the treating chamber 8.

For proper sealing of the treating chamber 8, a top cover 11 is provided and is removably sealed to the treating apparatus 6 by cooperation of threaded hold-down clamps 36 with hold-down clamp rods 34 which are secured on their lower ends to the heat radiating panel 16 shown in FIG. 1.

Refer now to FIG. 1 which is a schematic view taken through section 1—1 of FIG. 2.

In FIG. 1 there is shown a treating apparatus comprising the developing chamber 8 and supply chamber 10 separated by heat radiating panel 16. Positioned below and aligned with the

reactive gas supply port **18** is the discharge end of centrifugal blower **20**. The blower is secured to the bottom of the heat radiating panel **16** with the intake of the blower in the supply chamber **10**, and its discharge in the developing chamber **8**.

An electrical heating element **38**, such as a Calrod resistance unit, is positioned in a supply chamber **10** and juxtaposed adjacent the heat radiating panel **16**. Preferably, the heating element **38** is secured to the heat radiating panel by annular ceramic spacers. An adjustable thermostat **40** is electrically connected, to the heating element **38**, in series, and is preset to obtain the desired temperature. In the embodiment shown, the thermostat is positioned adjacent to the heating element **38**, and also secured to the heat radiating panel **16**.

The prime gas supply is fed from the anhydrous ammonia tank **24** through the pressure regulating valves **26** to a fail-safe solenoid controlled valve **42** connected into the electrical system so that when the electric current is turned off by the main electric switch **56** the valve will close, and no additional ammonia will be fed to the apparatus. From the fail-safe valve **42** the anhydrous ammonia gas enters an adjustable flow meter **28** where the input flow of anhydrous ammonia gas into the supply chamber is further controlled by adjusting means such as a knob **46** on the flow meter. The anhydrous ammonia gas is fed from the flow meter into the supply chamber **10** through a conduit to an inlet nozzle **30** positioned at and near the return gas port **22**. The gas conduit is sealed into the apparatus by well-known means such as washers and gaskets.

When in operation, the centrifugal blower causes a circulation and movement of the gases from the gas return port **22** to and through the gas supply port **18** into the developing chamber **8**. The newly supplied anhydrous ammonia mixes with the gases present and moves along to the intake of the centrifugal blower **20**. During its movement through the supply chamber, the prime gas, as well as the recirculating air and gases, is subjected to convection, conduction, and radiant heat from the heating element **38** and heat radiating panel **16**, to maintain the gases at the desired temperature level.

An indicating thermometer **48** is affixed to the cover **11** with the temperature indicator outside the apparatus and the probe element arranged to sense the temperature of gas placed at the mouth of the gas supply port **18**. The thermometer probe element is sealed into cover **11** of the chamber **8** by use of gaskets and washers. Preferably the gas supply port **18** and the gas return port **22** are positioned at opposite ends of the developing chamber **8** to provide uniform gas circulation and insure temperature uniformity therein. Although the gas supply and return ports have been shown as circular and positioned centrally on the apparatus longitudinal axis, obvious modifications can be made to accomplish varied desired gas flows.

The heat radiating panel **16** is preferably conterminous with the treating apparatus to sectionalize the apparatus into two chambers, a developing chamber **8** and a supply chamber **10** bounded by walls **9** of the apparatus. Preferably, the gas supply chamber **10** is of a volume to insure uniformity of temperature and concentration of gas being supplied to the developing chamber **8**. In the embodiment shown, the heat radiating panel **16** has been placed to divide the apparatus into such proportion that the volume of the supply chamber **10** is generally about twice that of the developing chamber **8**.

In the apparatus shown (also see FIGS. **4**,**5**), the heat radiating panel **16** is secured to the lip **50** of conterminous rectangular apron **52** which is fixed by removable screws to the interior of walls **9** of the apparatus. The snug machine fit of the heat radiating panel **16** into apron **52**, and the apron **52** into the walls **9** of the apparatus, is sufficient to compartmentize the apparatus into the two chambers **8**, **10**. The number of idler and transport rollers **12** are selected to provide the proper residence time in the film's travel through the developing chamber **8**. Preferably the rollers **12** are secured into the panel **16** such that the film **2** in its travel through the developing chamber will be subjected to the radiant heat from the panel **16** positioned parallel to the direction of film travel.

In the development of latent images on diazo film by use of ammonia, some moisture vapor is desirable. However, it has been found that the moisture vapor level need not be at the vapor saturation level at the temperature of use. In the embodiment shown, a sponge **32**, secured to an end wall of **6** by clips, is provided in the developing chamber **8** adjacent the gas supply inlet port **18**. A sponge **32**, saturated with water and placed in the chamber **8**, will allow continuous, slow and sufficient evaporation of moisture to the reactive gas to permit operation practically all day when using the conditions set forth in the example. The moisture reservoir can also be fed continuously from an outside gas sealed source, if desired.

The cover **11** used to seal the top of the apparatus is secured tightly by means of threaded hold-down clamps **36** cooperating with clamp rods **34** to allow ready removal of the cover to thread the film in case of film breakage, to rewet the sponge moisture reservoir, or for other adjustment. A blocked cell foam type resilient neoprene gasket **74** is preferably used to provide a gas seal around the top surface of walls **9** of the apparatus.

In FIGS. **1** and **2** the position of the film **2** in its travel through the developing chamber and around the idler and transport rollers **12** is shown. The rollers are shown at the ends of the developing chamber, and are so positioned to obtain the serpentine path to obtain the proper residence time for the conditions of temperature, gas concentration, pressure and rate of travel of film. However, it is to be understood that the travel through the developing chamber can be obtained by other arrangements of rollers, by the use of belts, drums and the like.

In the embodiment described, rollers are secured vertically in the heat radiating panel **16**. Preferably they are idler rollers set in roller bearings to minimize rotational torque. The movement of the film **2** through the developing chamber can result from the forces of an external driven uniform torque windup reel or collecting station, and the film can be fed into the developing chamber from properly clutched unwind reels to prevent overfeed or directly under tension from an image printing station. If it is desired, some or all of the rollers may be driven. It will be appreciated, by those skilled in the art, that when rollers are used they may have to be crowned or to be concave to produce proper tracking of the film in the system.

The electrical system in the apparatus is shown as being supplied from a main 110 volt line **54** and controlled through a single switch **56**. Obviously, fuses or current control devices can be put at any desired location in the electrical circuit. All units are preferably connected in a common parallel circuit, except the thermostat and heating element. The circuitry can be easily traced in FIG. **1**. A neon light **58** is provided to indicate current input to the system. Preferably, the solenoid controlled fail-safe valve **42** on the supply line of anhydrous ammonia is also controlled by the main apparatus switch **56** so that when the apparatus is not in use, and the main switch is turned off, all elements in the system are deactivated, including the anhydrous ammonia supply so that it need not be turned off separately.

It is also to be understood that preferably the heat radiating panel, which can be aluminum, is juxtaposed near and is parallel to the travel of the film as it advances through the developing chamber. In this manner the heat radiating panel **16** heats both the gaseous environment in the chamber **8** and also tends to heat the film itself, thus reducing the time needed for development. Obviously, the heat input and positioning of elements are controlled to maintain proper temperature and to prevent distortion of the film. A heat radiating element in the supply chamber to preheat the incoming anhydrous ammonia gas, which cools when expanded, is also preferred. In the embodiment described, the same panel separates the chambers and acts as a heat radiating source for both chambers.

Another aspect of this invention is to provide a method and means to allow ingress through the inlet port in the sealed apparatus and egress from the outlet port of the sealed apparatus

without any substantial permeation or migration of gases from or into the sealed apparatus. I have done this by securing to the inlet port and to the outlet port of the apparatus a pressure limiting capsule which will be described in its structure and embodiment wherein unexposed diazo microfilm, commonly used as a storage means for records, is first exposed to utraviolet light of the proper wavelength and frequency through an original print, and is then developed in a moisturized ammonia atmosphere in the treating apparatus hereinbefore described.

Refer now to FIG. 3 which is an enlarged perspective view of one embodiment of the pressure limiting capsule **14**. The capsule **14** as shown is comprised of two cellular pressure isolation zones, each formed of spaced thin flexible resilient diaphrams **62** having a longitudinal slit **64** centrally located. A plan view of the slit **64** on diaphram **62** is shown in FIG. 6. The diaphram is shown rectangular as a convenient shape for microfilm to pass vertically therethrough. The length of the slit is at least that of the width of the film, but in this embodiment the slit can be longer without affecting performance of the apparatus. Holes **66** are provided in the corners of the diaphram for securing means such as screws to pass therethrough.

The diaphrams **62** are spaced from each other and cellular zones are formed therebetween by using channeled spacers **68** between each pair of diaphrams. For sealing the outermost diaphram to the capsule, an additional channeled spacer **68** is used. In the embodiment shown, three diaphragms form two cellular pressure isolation zones. For sealing the capsule to the outlet port of the treating apparatus, the innermost diaphram **62A** is faced directly onto the outlet port **60**, resulting in a gasketing seal for the chamber **8**, as well as a cellular zone. As used for thin film of about 1 to 5 mils in thickness, the slit **64** in the diaphram **62** refers to a cut-through portion without removal of any material from the diaphram. It is to be understood that the outer dimensions of the diaphram and spacers are such to completely seal the outlet port **60**. The slit **64** in diaphram **62** is sized to cooperate with the channel **69** in spacers **68** to allow the film to pass therethrough without scraping, and provide the cellular pressure isolation zones.

Refer now to FIG. 4 which is an enlarged view of Section 4—4 of FIG. 2 showing film **2'** passing from roller **12** through outlet or exit port **60** of developing chamber **8**. The film **2'** now developed passes from guide roller **12** through the slit of diaphram **62A** into a first cellular pressure isolation zone **70A**, formed of diaphram **62A** and diaphram **62B** in cooperation with channeled spacer **68A**, then through the slit in diaphram **62B** into a second cellular zone **70B** formed from spaced diaphrams **62B** and **62C** with channeled spacer **68B**. The film then passes through the slit of diaphram **62C** into the ambient atmosphere to the collecting station.

Any permeation of gas from the developing chamber **8** into the first cellular zone **70A** is minimized by the close contact of the film **2'** passing through the slit **64** of the first flexible resilient diaphram **62A**. As a result of the slow permeation, the partial pressure of ammonia gas is less in the first zone than in the treating or developing chamber. The cooperating diaphram **62B** for the first cellular zone **70A** will also minimize permeation from the first zone **70A** to a second zone **70B** by the intimate contact of the slit **64** of the flexible resilient diaphram **62B** about the moving film.

A second cellular pressure isolation zone **70B** can be provided to further reduce the permeation by having a second zone wherein the partial pressure of the ammonia is further reduced and is less than that in the first zone. Diaphram **62B** can be used as a common diaphram for the two zones and can cooperate with diaphram **62C** and spacer **68B** to form the second zone. A third spacer **68C** is shown to conveniently lock diaphram **62C** in position. It is to be understood that the channels of the spacers are aligned about the slits of the diaphrams and that the slits of each of the diaphrams are aligned with the slit of the cooperating diaphram to form proper intimate contact with the moving film and perform its sealing function. The pressure limiting capsule can be conveniently secured to the outlet by means of screws **82** with all parts in alignment as shown.

FIG. **8** is an embodiment of a preassembled pressure limiting capsule that can be snapped into place and locked in position by use of screws **82**. Slit diaphrams **62** cooperate with annual spacers **68** to form a three-zone capsule. It is obvious that three or more zones can be formed with additional diaphrams and spacers.

Also shown in FIG. 4 is the top **11** sealed to the chamber **8** with gasket **74** preferably comprised of a resilient blocked cell foamed neoprene fixed to top surface of walls **9**. For additional sealing about the top, an "O" ring gasket **76** can be used peripherally set into cover **11**.

FIG. **5** is a view of Section **5—5** of FIG. **4** showing the passage of the film **2'** from the developing chamber **8** through cellular pressure isolation zones **70A** and **70B** and through the aligned slits **64** of the diaphrams **62A**, **62B**, and **62C** to the collection station, not shown. The edges of the slits **64** of the diaphrams are in intimate contact with the film.

In the embodiment shown in FIG. **7**, the slit of the diaphram FIG. **6** is shown as a shaped cut-out product conforming portion referred to herein as an aperture **78**. Outwardly extending slits **80** are non cut-out portions, and can be provided at the ends of the aperture to minimize binding when oversize or nonaligned film is passed therethrough. The shape shown is useful when thick film, webs, foils, sheets and the like are to be passed through the capsule. The cut-out portion is shaped to provide intimate contact to minimize permeation of gases through the cellular zone during operation and at the same time to reduce the rubbing contact to an acceptable level to prevent binding, or scratching or damage to the film surface.

A pressure limiting capsule of the same type as described for the outlet port is provided for the inlet of the treating apparatus.

EXAMPLE I

A 35 mm. diazo type microfilm was properly exposed through a positive print, and the exposed, but undeveloped, film was then passed to and through the treating apparatus as shown in FIG. **1** through a pressure limiting capsule positioned on the inlet port and on the outlet port, each capsule comprised of two cellular pressure isolation zones having natural gum rubber sheet or about one-thirty second inch in thickness and about 3 inches long and 1 inch wide as the diaphram material. The slit was centrally located and of about 50 mm. length along the longitudinal axis. The cell spacers were about ¼ inch thick, 3 inches long and 1 inch wide, and having a central opening 2 inches long and ¼ inch wide. The ports in the treating apparatus were also 2 inches long and about ¼ inch wide. The capsules were secured to the apparatus with ordinary screws. The entire apparatus was approximately 12 inches wide, 12 inches high and 24 inches long, and sectionalized by an aluminum heat radiating panel to provide a developing chamber 4 inches high, 12 inches wide and 24 inches long. The rollers were arranged to provide about 24 feet of travel from the inlet to the outlet. After being treated, the film passed from the chamber through a pressure limiting capsule on the outlet port of the chamber to a windup reel. The input of anhydrous ammonia gas was regulated to about 0.5 to 1.0 (C.F.H.) cubic feet per hour as measured by a flow meter calibrated for air in C.F.H. at 10 p.s.i.g. at 70° F., with an anhydrous ammonia gas supply pressure within the chambers which pressure was from 0.1 to 5 inches of water. The thermostat was set to obtain a temperature of the gas flowing from the supply chamber of 180°–195° C. A cellulose sponge 3 inches × 5 inches × ½ inch thick was saturated with water and placed in the developing chamber before the run. About 15,000 feet of exposed film were developed continuously through the treating apparatus by splicing 1,000-foot rolls together. The film was moving at 40 feet per minute and was properly developed. There was no perceptible odor of ammonia in the environ-

ment of the apparatus, although it was in an unvented area having ordinary room circulation. The sponge die not have to be rewet during the entire run.

EXAMPLE II

To further test the effectiveness of the sealing by the pressure limiting capsule, undeveloped diazo film was fed into and through the apparatus having the inlet and outlet sealed with the capsule described herein. The sponge water reservoir was wetted and inserted in the developing chamber. The top was sealed and anhydrous ammonia was fed from the prime supply tank into the chamber as in Example I. The temperature was raised to 170° F., and the gas within the chamber circulated by the centrifugal blower as described in Example I.

After standing for 24 hours, the film was removed and examined. The film contained within the chamber was fully developed and black. The area of the film within the confines of the first cellular isolation was slightly developed, while the film within the confines of the second or outermost cellular zone was virtually undeveloped, indicating extremely small permeation of gas from the treating chamber to the first zone, and from the first zone to the second zone.

The pressure limiting capsule will provide sealing to a chamber having a partial pressure of gas or air above or below that of ambient atmospheric pressure. By having cellular pressure isolation zones at pressures intermediate that in adjacent zones or areas, the permeation of the gas at above or below (vacuum) gauge pressures due to the forces of the partial pressures of gases is minimized. Obviously, the number of cellular zones to be used to accomplish the desired results will depend upon pressures used.

It has been found that then natural gum rubber sheeting cut and slit to the proper dimensions is an ideal diaphram material for use with thin film such as microfilm. Obviously, those skilled in the art can find other compositions to fulfill the desired flexibility and resiliency properties needed to form the cellular pressure isolation zones with a minimum of binding and rubbing on the surface of the film as it passes through the slits.

This invention has been described in particular with reference to a preferred embodiment as applied to the developing of latent images, but it is to be understood that the disclosure is illustrative only, and that the method and apparatus have usefulness in other fields and applications, and it will be obvious to those skilled in the art that many modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

What is claimed is:

1. A sealed pressurized apparatus having an inlet port and an outlet port for developing a latent image on a flexible web by a reactive gas and comprised of:
   a. a sealed developing chamber having a pressure limiting capsule to seal the inlet port and the outlet port of said chamber, while allowing ingress and egress of the web to and from said chamber;
      1. means in said developing chamber to advance the web to and through the chamber;
   b. a sealed gaseous supply chamber positioned adjacent said developing chamber;
      1. means to supply reactive gas to said supply chamber;
   c. a heat radiating panel conterminous with and separating the developing chamber to heat both supply and developing chambers, said heat radiating panel having;
      1. a reactive gas supply port leading to the supply chamber;
      2. a spaced return gas port leading from the developing chamber to supply chamber to allow passage of the reactive gas from said supply chamber to the developing chamber and return;
   d. means to heat said heat radiating panel;
   e. means to cause flow of the reactive gas from the supply chamber to the developing chamber and about the advancing web;
   f. a moisture reservoir to provide moisture vapor formation in said developing chamber.

2. The apparatus of claim 1 wherein the means to advance the web through the developing chamber are rollers secured to the heat radiating panel, and the panel is juxtaposed and parallel to the travel of the advancing web.

3. The apparatus of claim 1 wherein the pressure limiting capsule is comprised of at least one cellular pressure isolation zone, said cellular zone comprised of spaced sealed thin flexible resilient diaphrams, each diaphram having at least one slit of sufficient length to allow passage of the web therethrough, and the slit of each diaphram aligned with the slit of the adjacent diaphram.

4. The apparatus of claim 3 wherein the diaphram is composed of natural gum rubber.

5. The apparatus of claim 3 wherein the diaphram is comprised of natural gum rubber, the slit in the diaphram is of a length at least equal to the width of the web, and said capsule is comprised of at least two pressure isolation cells formed from at least three diaphrams.

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